How are stroke patients cared for in the US?

A STATISTICAL ANALYSIS OF FACTORS AFFECTING THE LIKELIHOOD OF RECEIVING SPEECH LANGUAGE TREATMENT FOR APHASIA, DYSARTHRIA, AND DYSPHAGIA IN STROKE AFTERCARE

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Stakeholder

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- Research Data Analyst at the Observational Health Data Sciences and Informatics Center (OHDSI) at the Roux Institute

Presentation Overview

- Describe goals of the semester-long project
- Dataset creation
- Model creation
- Results
- Limitations
- Key takeaways
- Next steps

Semester Goals

Goals

- Explore the Pharmetrix+ relational database through the OHDSI Lab to understand how stroke patients receive care
- Understand OMOP Common Data Model/Pharmetrix+ schema
- Work with my stakeholder to create a cohort of stroke patients based on inclusion criteria
- Perform exploratory analysis and visualization of the stroke patient cohort
- Replicate a German study that analyzed guideline adherence in the treatment of speech conditions after stroke using multivariate logistic regression

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Dataset Creation

Cohort creation

- Include all patients who have had more than stroke occurrence in an inpatient hospital setting
- The patient must have more than one stroke occurrences across multiple days
- The second occurrence must be within 6 months of the first

→ 174,000 patients

- Include patients that have 6 months of observation before and after the first stroke occurrence

→ 67,128 patients

- Include patients that have had more than one diagnosis of a speech disorder (aphasia, dysphagia, and/or dysarthria)
- Occurrences of the speech disorder must occur across multiple days

→ 25,428 patients

- Include patients 18 years or older at time of stroke occurrence

→ 25,361 patients

Speech Disorders

- Aphasia– Disorder that impairs the expression and understanding of spoken and written language
- Dysphagia – Disorder associated with patients who difficulty swallowing
- Dysarthria - Speech disorder that makes it difficult to speak clearly due to issues with the muscles that control speech

Study replication

Original Study

- Citation: Schindel D, Mandl L, Schilling R, Meisel A, Schenk L (2022) Guideline adherence in speech and language therapy in stroke aftercare. A health insurance claims data analysis.

- 4,486 stroke patients in Germany who were diagnosed with specific disorders or received speech therapy

- Built logistic and linear regression models for 6 target variables including:
  1. **Whether a stroke patient with a speech disorder received speech-language therapy (SLT)**
  2. The time gap between inpatient discharge and initiation of SLT
  3. Average frequency of SLT sessions

Target Variable

Variable	Data Type	Levels
SLP_TREATMENT_STATUS	Binary	0 = Patient did not receive speech-language therapy following their stroke 1 = Patient received speech-language therapy following stroke

Independent Variable definitions

Variable	Data Type	Levels
HAS_PARKINSONS	Binary	0 = Patient does not have Parkinson's Disease 1 = Patient was diagnosed with Parkinson's up to 6 months before or 30 days after the stroke
HAS_MIGRAINE	Binary	1 = Patient was diagnosed with Migraine…
HAS_DEPRESSION	Binary	1 = Patient was diagnosed with Depression…
HAS_DEMENTIA	Binary	1 = Patient was diagnosed with Dementia…
HAS_PARALYSIS	Binary	1 = Patient was diagnosed with Paralysis within 30 days of the stroke
HAS_ISCHEMIC_STROKE	Binary	1 = Patient was diagnosed with an ischemic stroke within 30 days of the first stroke occurrence

Independent Variable definitions

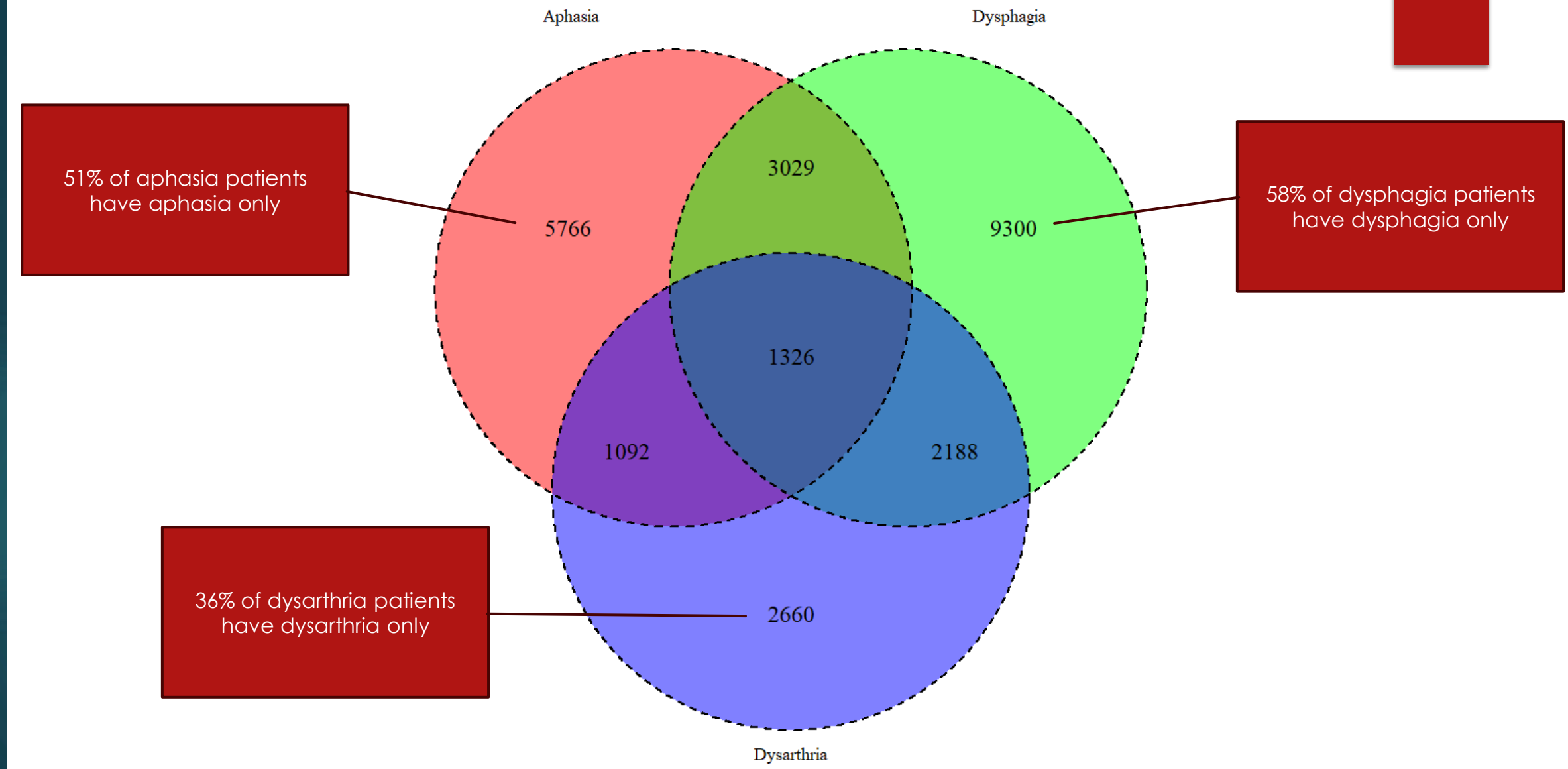
Variable	Data Type	Levels	Notes about Feature Engineering
SEVERITY	Nominal	Mild = Initial inpatient stay following stroke lasted less than 8 days Severe = Inpatient stay lasted 8 or more days	Decision to use 8 day severity threshold made by Schindel, et al.
GENDER	Nominal	Female or Male	
AGE_GROUP	Nominal	"18-29", "30-39", "40-49", "50-59", "60-69", "70-79", "80+"	The continuous variable of age was binned into age groups in the final models because patients born before or during 1937 are all binned into one year
CCI (Charlson Comorbidity Index)	Ordinal	Each patient receives a weighted numerical score that is used to predict risk of death of based on a long list of possible health conditions	Median CCI score imputed to 1623 (6.3%) patients missing data

Table 1 – Descriptive Statistics

	aphasia (N=11213)	dysarthria (N=7266)	dysphagia (N=15843)	Total (N=25361)
Parkinson's Disease				
0	10941 (97.6%)	7022 (96.6%)	15056 (95.0%)	24396 (96.2%)
1	272 (2.4%)	244 (3.4%)	787 (5.0%)	965 (3.8%)
Migraine				
0	10574 (94.3%)	6922 (95.3%)	15119 (95.4%)	24031 (94.8%)
1	639 (5.7%)	344 (4.7%)	724 (4.6%)	1330 (5.2%)
Depression				
0	8939 (79.7%)	5772 (79.4%)	11859 (74.9%)	19622 (77.4%)
1	2274 (20.3%)	1494 (20.6%)	3984 (25.1%)	5739 (22.6%)
Insomnia				
0	9038 (80.6%)	5766 (79.4%)	12492 (78.8%)	20170 (79.5%)
1	2175 (19.4%)	1500 (20.6%)	3351 (21.2%)	5191 (20.5%)
Dementia				
0	9154 (81.6%)	6191 (85.2%)	11698 (73.8%)	19859 (78.3%)
1	2059 (18.4%)	1075 (14.8%)	4145 (26.2%)	5502 (21.7%)
Paralysis				
0	6917 (61.7%)	3557 (49.0%)	9661 (61.0%)	15793 (62.3%)
1	4296 (38.3%)	3709 (51.0%)	6182 (39.0%)	9568 (37.7%)
Ischemic Stroke				
0	1184 (10.6%)	495 (6.8%)	2630 (16.6%)	3478 (13.7%)
1	10029 (89.4%)	6771 (93.2%)	13213 (83.4%)	21883 (86.3%)
Severity				
mild stroke	8647 (77.1%)	5804 (79.9%)	10834 (68.4%)	18960 (74.8%)
severe stroke	2566 (22.9%)	1462 (20.1%)	5009 (31.6%)	6401 (25.2%)
Gender				
F	6125 (54.6%)	3565 (49.1%)	8337 (52.6%)	13389 (52.8%)
M	5088 (45.4%)	3701 (50.9%)	7506 (47.4%)	11972 (47.2%)

	aphasia (N=11213)	dysarthria (N=7266)	dysphagia (N=15843)	Total (N=25361)
Age Group				
18-29	51 (0.5%)	29 (0.4%)	76 (0.5%)	125 (0.5%)
30-39	118 (1.1%)	60 (0.8%)	113 (0.7%)	232 (0.9%)
40-49	334 (3.0%)	210 (2.9%)	327 (2.1%)	656 (2.6%)
50-59	921 (8.2%)	665 (9.2%)	942 (5.9%)	1889 (7.4%)
60-69	1863 (16.6%)	1307 (18.0%)	2266 (14.3%)	4006 (15.8%)
70-79	3418 (30.5%)	2224 (30.6%)	4626 (29.2%)	7490 (29.5%)
80+	4508 (40.2%)	2771 (38.1%)	7493 (47.3%)	10963 (43.2%)
Age *				
Mean (SD)	72.8 (11.0)	72.5 (10.8)	74.4 (10.2)	73.4 (10.8)
Median [Min, Max]	77.0 [18.0, 84.0]	76.0 [18.0, 84.0]	79.0 [18.0, 84.0]	78.0 [18.0, 84.0]
Charlson Comorbidity Index				
Mean (SD)	4.73 (2.84)	4.80 (2.80)	5.10 (2.91)	4.90 (2.87)
Median [Min, Max]	4.00 [1.00, 20.0]	4.00 [1.00, 19.0]	4.00 [1.00, 21.0]	4.00 [1.00, 21.0]
Insurance Plan				
Commercial HDHP	266 (2.4%)	161 (2.2%)	220 (1.4%)	478 (1.9%)
Commercial PPO/HMO	2138 (19.1%)	1402 (19.3%)	2408 (15.2%)	4483 (17.7%)
Medicaid	80 (0.7%)	52 (0.7%)	109 (0.7%)	185 (0.7%)
Medicare Advantage	3679 (32.8%)	2510 (34.5%)	5292 (33.4%)	8381 (33.0%)
Medicare Gap	5012 (44.7%)	3116 (42.9%)	7791 (49.2%)	11766 (46.4%)
Missing	38 (0.3%)	25 (0.3%)	23 (0.1%)	68 (0.3%)
SLP Treatment Status				
0	6327 (56.4%)	4098 (56.4%)	8919 (56.3%)	15204 (60.0%)
1	4886 (43.6%)	3168 (43.6%)	6924 (43.7%)	10157 (40.0%)

* We drop age as a continuous variable in favor of age groups in the final models because patients born before or during 1937 are all binned into one year



51% of aphasia patients have aphasia only

58% of dysphagia patients have dysphagia only

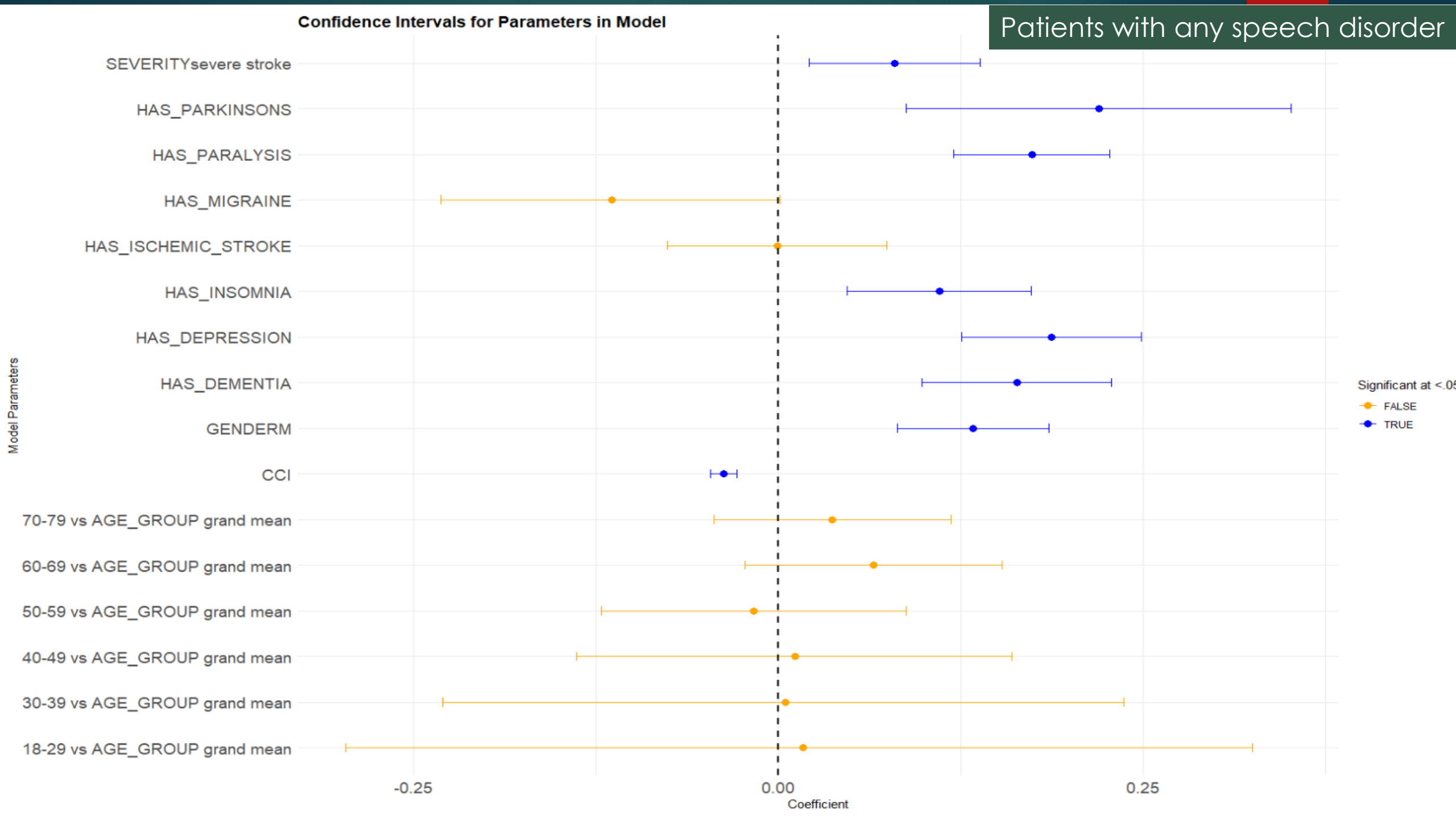
36% of dysarthria patients have dysarthria only

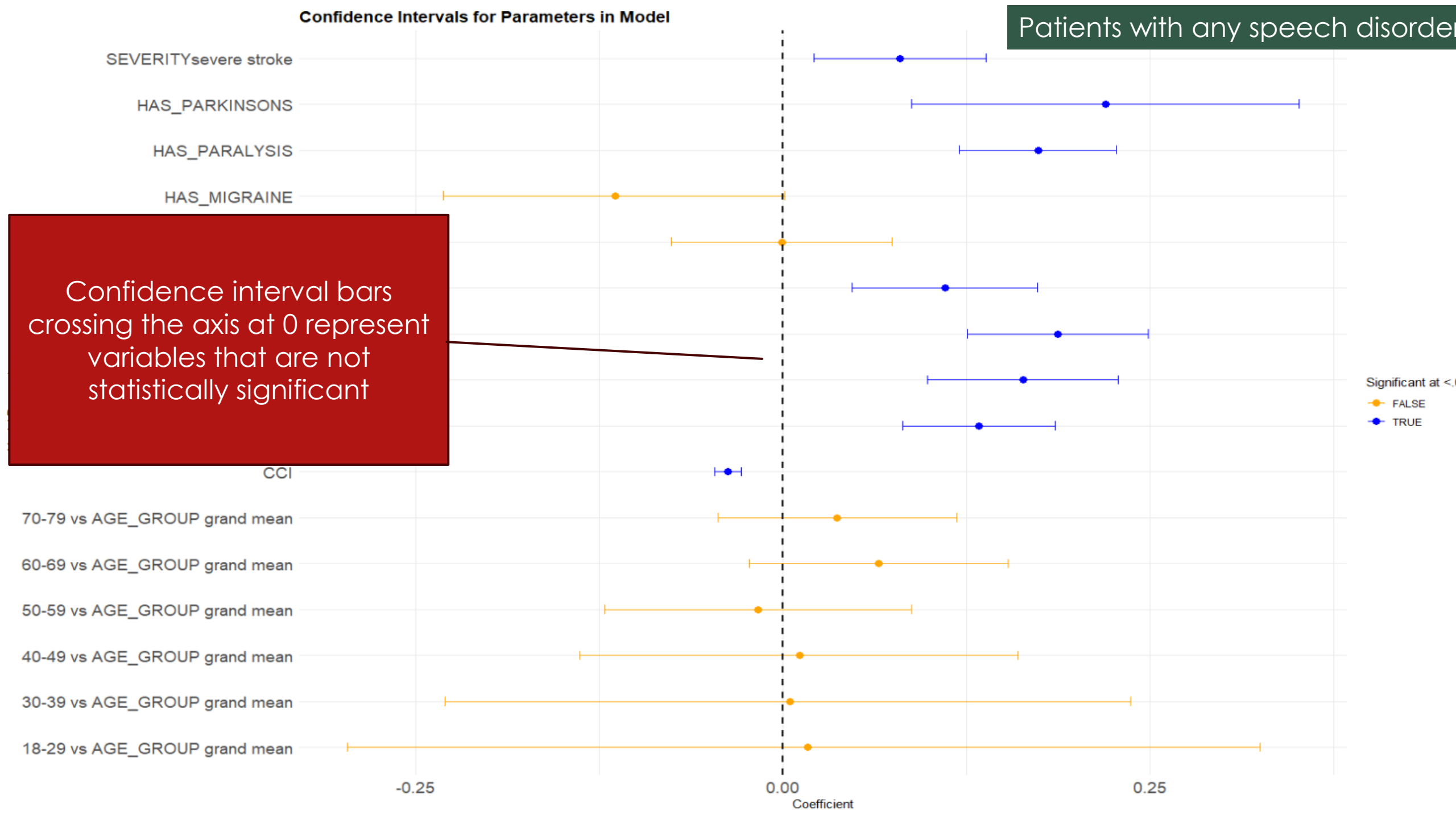
Results

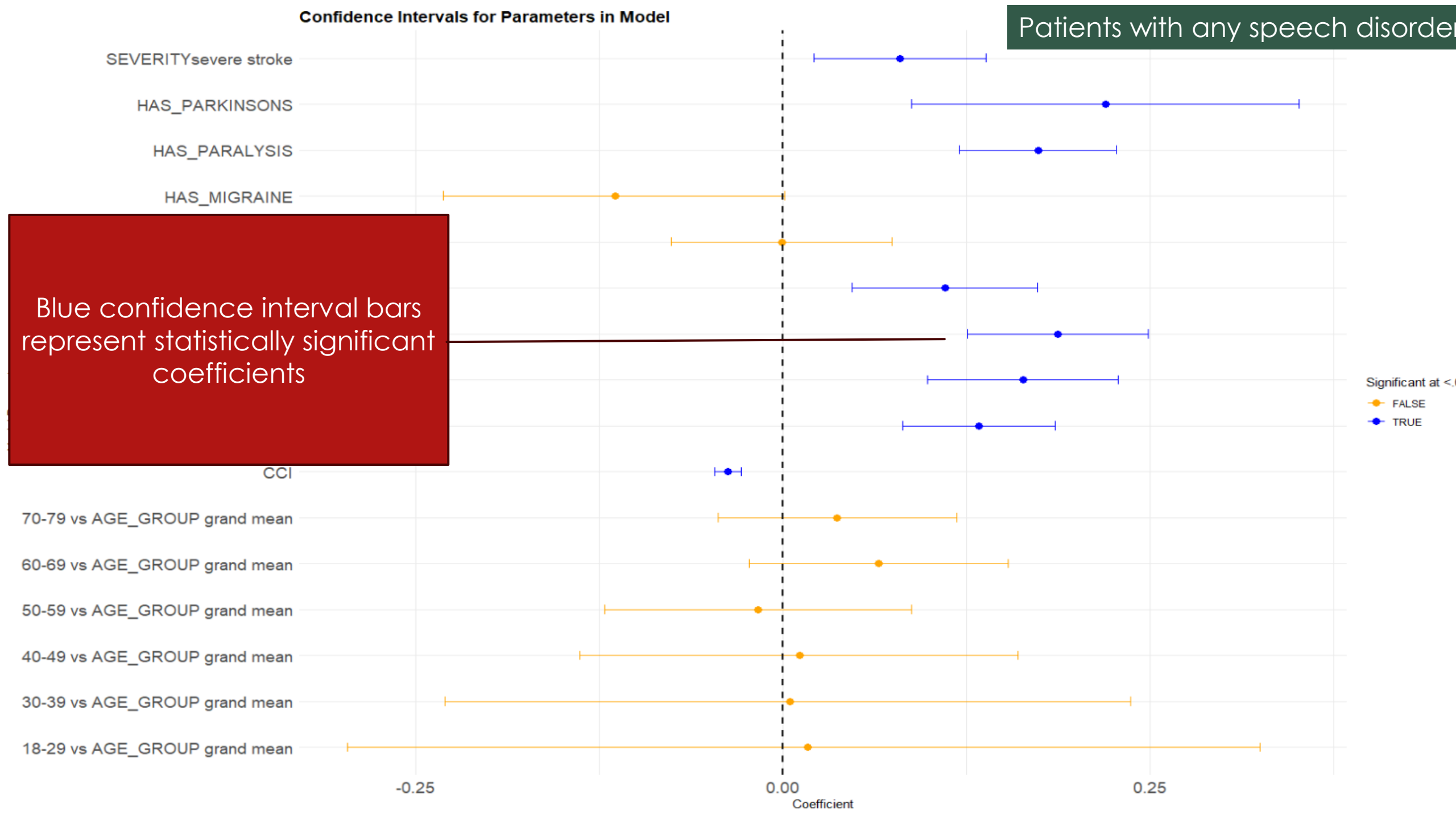
Parameter	Coefficient	SE	95% CI	z	df	p
(Intercept)	-0.44	0.05	[-0.55, -0.34]	-8.18	Inf	< .001
HAS PARKINSONS	0.22	0.07	[0.09, 0.35]	3.26	Inf	0.001
HAS MIGRAINE	-0.11	0.06	[-0.23, 0.00]	-1.93	Inf	0.054
HAS DEPRESSION	0.19	0.03	[0.13, 0.25]	5.95	Inf	< .001
HAS INSOMNIA	0.11	0.03	[0.05, 0.17]	3.43	Inf	< .001
HAS DEMENTIA	0.16	0.03	[0.10, 0.23]	4.92	Inf	< .001
HAS PARALYSIS	0.17	0.03	[0.12, 0.23]	6.40	Inf	< .001
HAS ISCHEMIC STROKE	-7.66e-04	0.04	[-0.08, 0.07]	-0.02	Inf	0.984
SEVERITY [severe stroke]	0.08	0.03	[0.02, 0.14]	2.66	Inf	0.008
GENDER [M]	0.13	0.03	[0.08, 0.19]	5.06	Inf	< .001
AGE GROUP [1]	0.02	0.16	[-0.30, 0.33]	0.11	Inf	0.914
AGE GROUP [2]	5.08e-03	0.12	[-0.23, 0.24]	0.04	Inf	0.966
AGE GROUP [3]	0.01	0.08	[-0.14, 0.16]	0.15	Inf	0.883
AGE GROUP [4]	-0.02	0.05	[-0.12, 0.09]	-0.31	Inf	0.754
AGE GROUP [5]	0.07	0.04	[-0.02, 0.15]	1.45	Inf	0.147
AGE GROUP [6]	0.04	0.04	[-0.04, 0.12]	0.89	Inf	0.371
CCI	-0.04	4.68e-03	[-0.05, -0.03]	-7.98	Inf	< .001

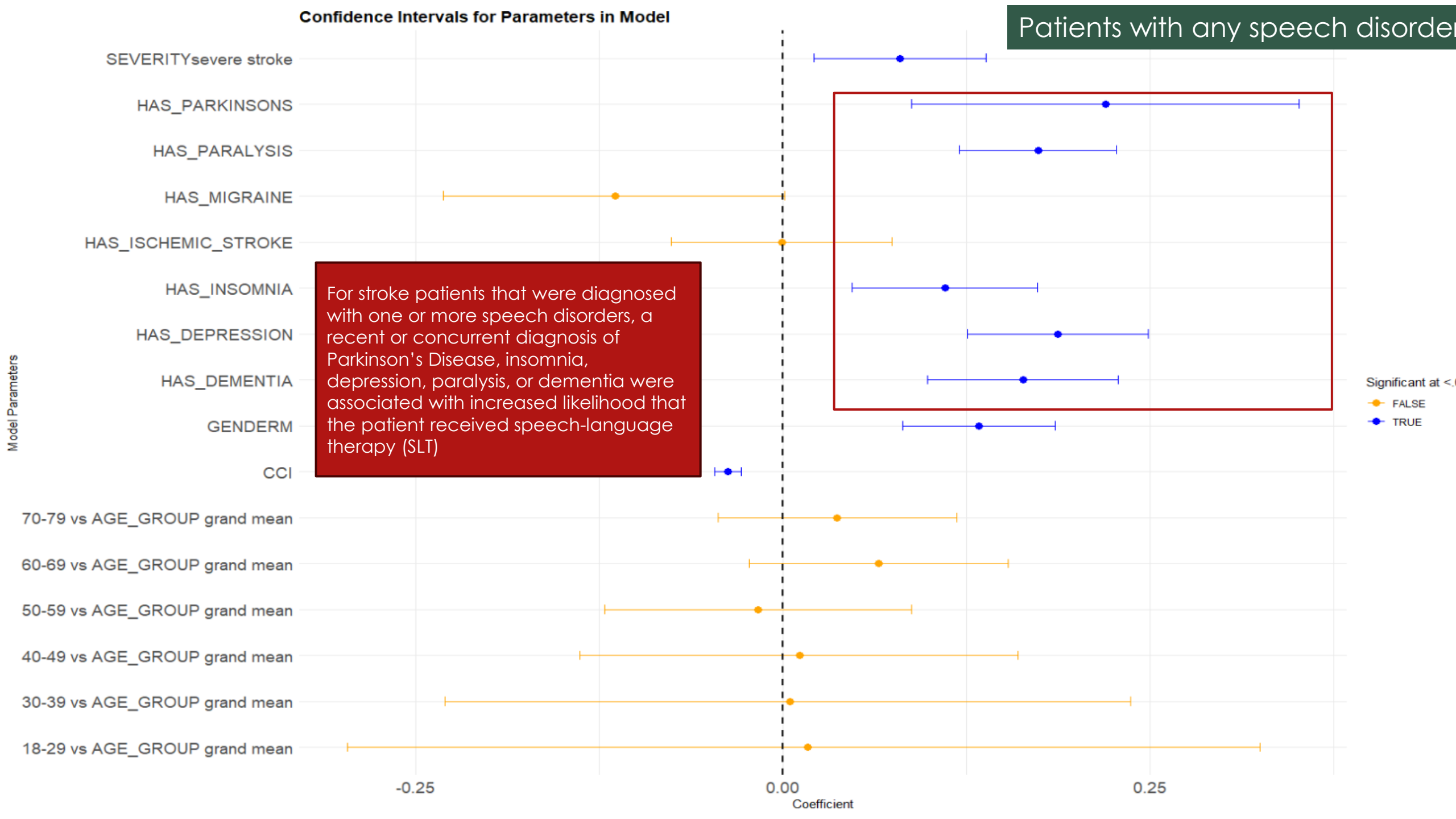
Model results for patients with any speech condition

Patients with any speech disorder




Confidence Intervals for Parameters in Model
Patients with any speech disorder
SEVERITYsevere stroke
HAS_PARKINSONS
HAS_PARALYSIS
HAS_MIGRAINE
CCI
70-79 vs AGE_GROUP grand mean
60-69 vs AGE_GROUP grand mean
50-59 vs AGE_GROUP grand mean
40-49 vs AGE_GROUP grand mean
30-39 vs AGE_GROUP grand mean
18-29 vs AGE_GROUP grand mean
-0.25
0.00
0.25
Coefficient
Significant at <.
FALSE
TRUE
Confidence interval bars crossing the axis at 0 represent variables that are not statistically significant


Confidence Intervals for Parameters in Model
Patients with any speech disorder
SEVERITYsevere stroke
HAS_PARKINSONS
HAS_PARALYSIS
HAS_MIGRAINE
CCI
70-79 vs AGE_GROUP grand mean
60-69 vs AGE_GROUP grand mean
50-59 vs AGE_GROUP grand mean
40-49 vs AGE_GROUP grand mean
30-39 vs AGE_GROUP grand mean
18-29 vs AGE_GROUP grand mean
-0.25
0.00
0.25
Coefficient
Significant at <.
FALSE
TRUE
Blue confidence interval bars represent statistically significant coefficients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Patients with any speech disorder
SEVERITYsevere stroke
HAS_PARKINSONS
HAS_PARALYSIS
HAS_MIGRAINE
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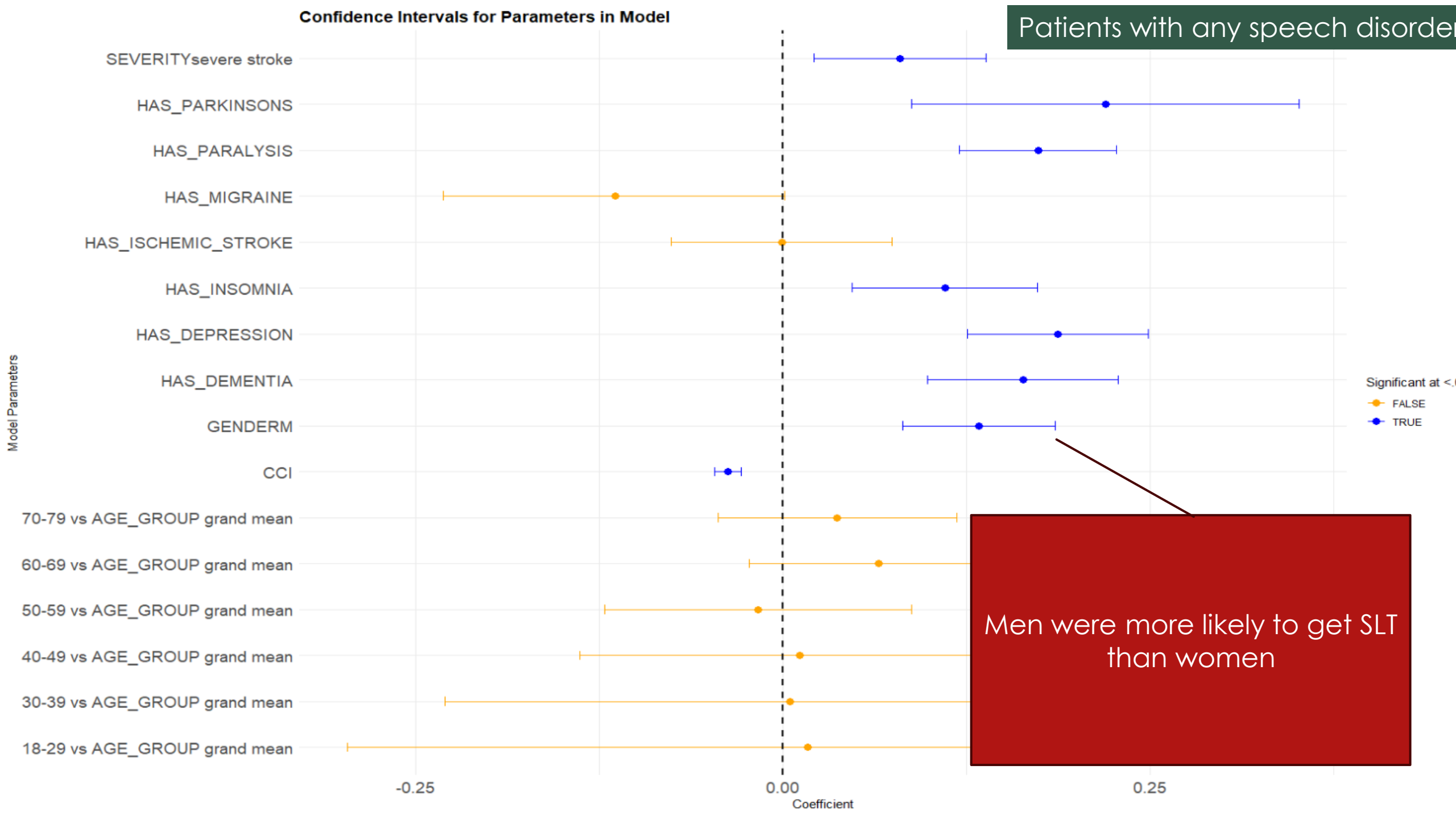
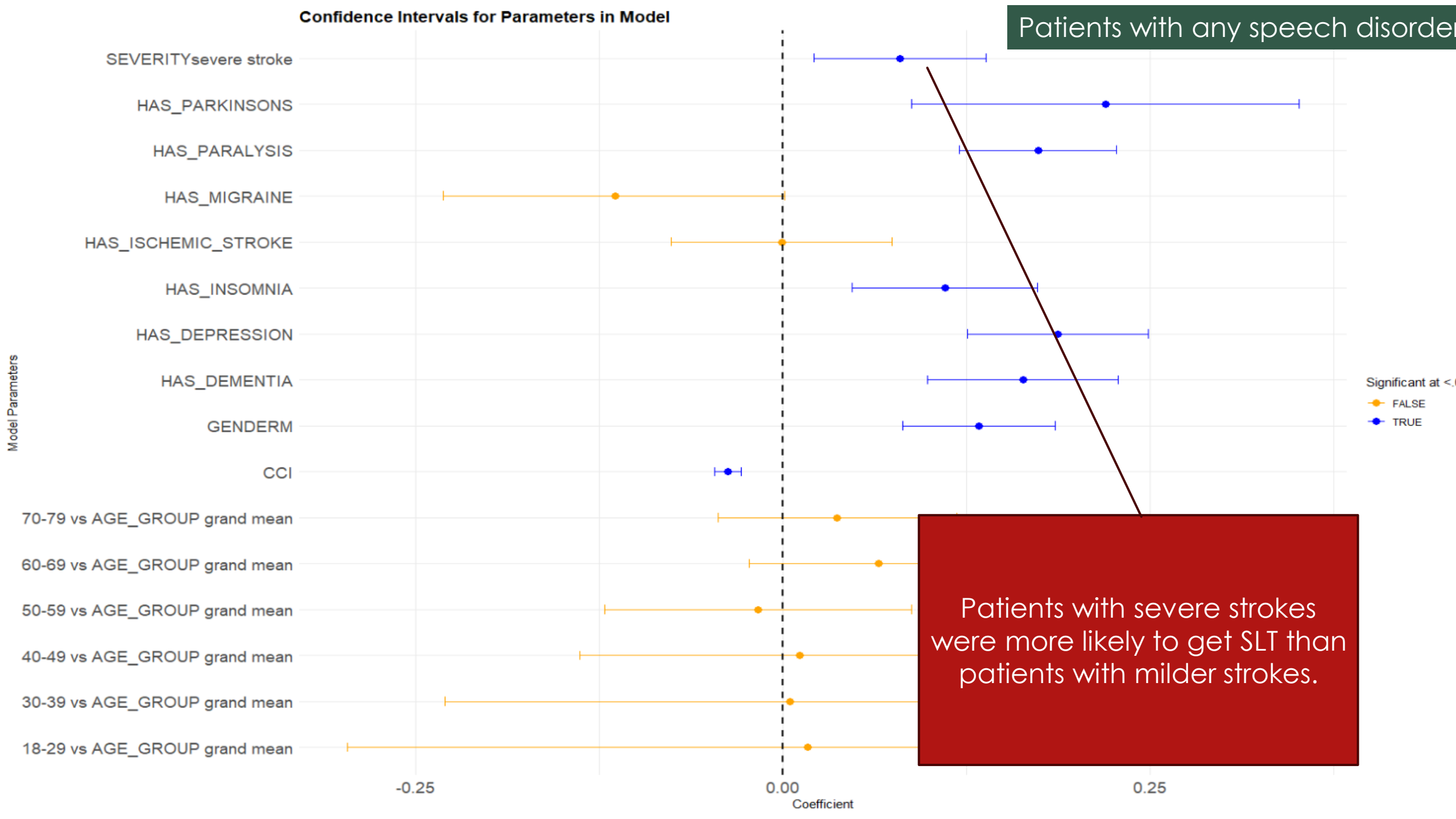
50-59 vs AGE_GROUP grand mean
40-49 vs AGE_GROUP grand mean
30-39 vs AGE_GROUP grand mean
18-29 vs AGE_GROUP grand mean
Model Parameters
For stroke patients that were diagnosed with one or more speech disorders, a recent or concurrent diagnosis of Parkinson's Disease, insomnia, depression, paralysis, or dementia were associated with increased likelihood that the patient received speech-language therapy (SLT)
Significant at <.
FALSE
TRUE
-0.25
0.00
0.25
Coefficient


Confidence Intervals for Parameters in Model
Patients with any speech disorder
SEVERITYsevere stroke
HAS_PARKINSONS
HAS_PARALYSIS
HAS_MIGRAINE
HAS_ISCHEMIC_STROKE
HAS_INSOMNIA
HAS_DEPRESSION
HAS_DEMENTIA
GENDERM
CCI
70-79 vs AGE_GROUP grand mean
60-69 vs AGE_GROUP grand mean
50-59 vs AGE_GROUP grand mean
40-49 vs AGE_GROUP grand mean
30-39 vs AGE_GROUP grand mean
18-29 vs AGE_GROUP grand mean
Model Parameters
-0.25
0.00
0.25
Coefficient
Significant at <.
FALSE
TRUE
Men were more likely to get SLT than women


Confidence Intervals for Parameters in Model
Patients with any speech disorder
SEVERITYsevere stroke
HAS_PARKINSONS
HAS_PARALYSIS
HAS_MIGRAINE
HAS_ISCHEMIC_STROKE
HAS_INSOMNIA
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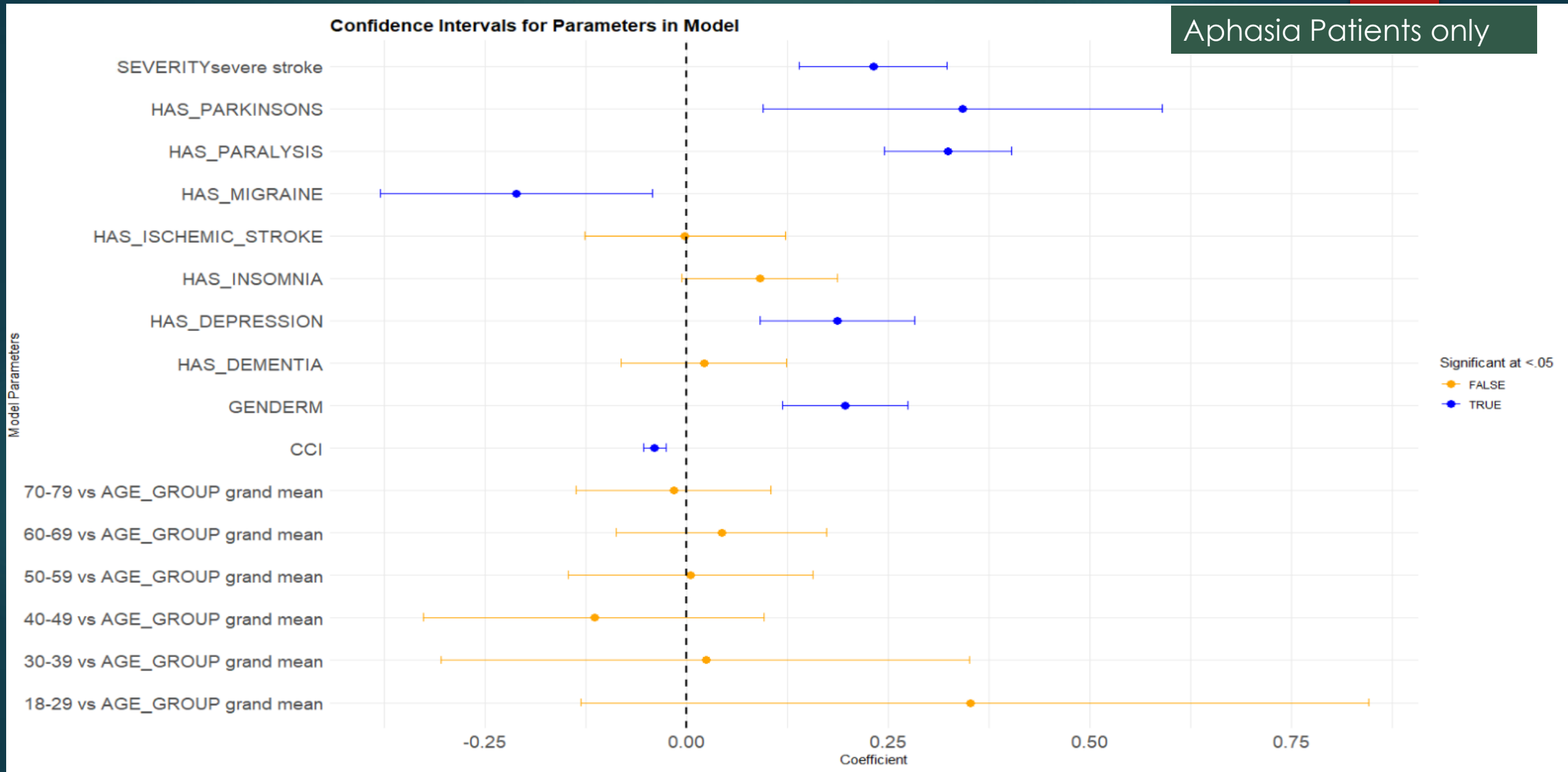
40-49 vs AGE_GROUP grand mean
30-39 vs AGE_GROUP grand mean
18-29 vs AGE_GROUP grand mean
Model Parameters
-0.25
0.00
0.25
Coefficient
Significant at <.
FALSE
TRUE
Patients with severe strokes were more likely to get SLT than patients with milder strokes.

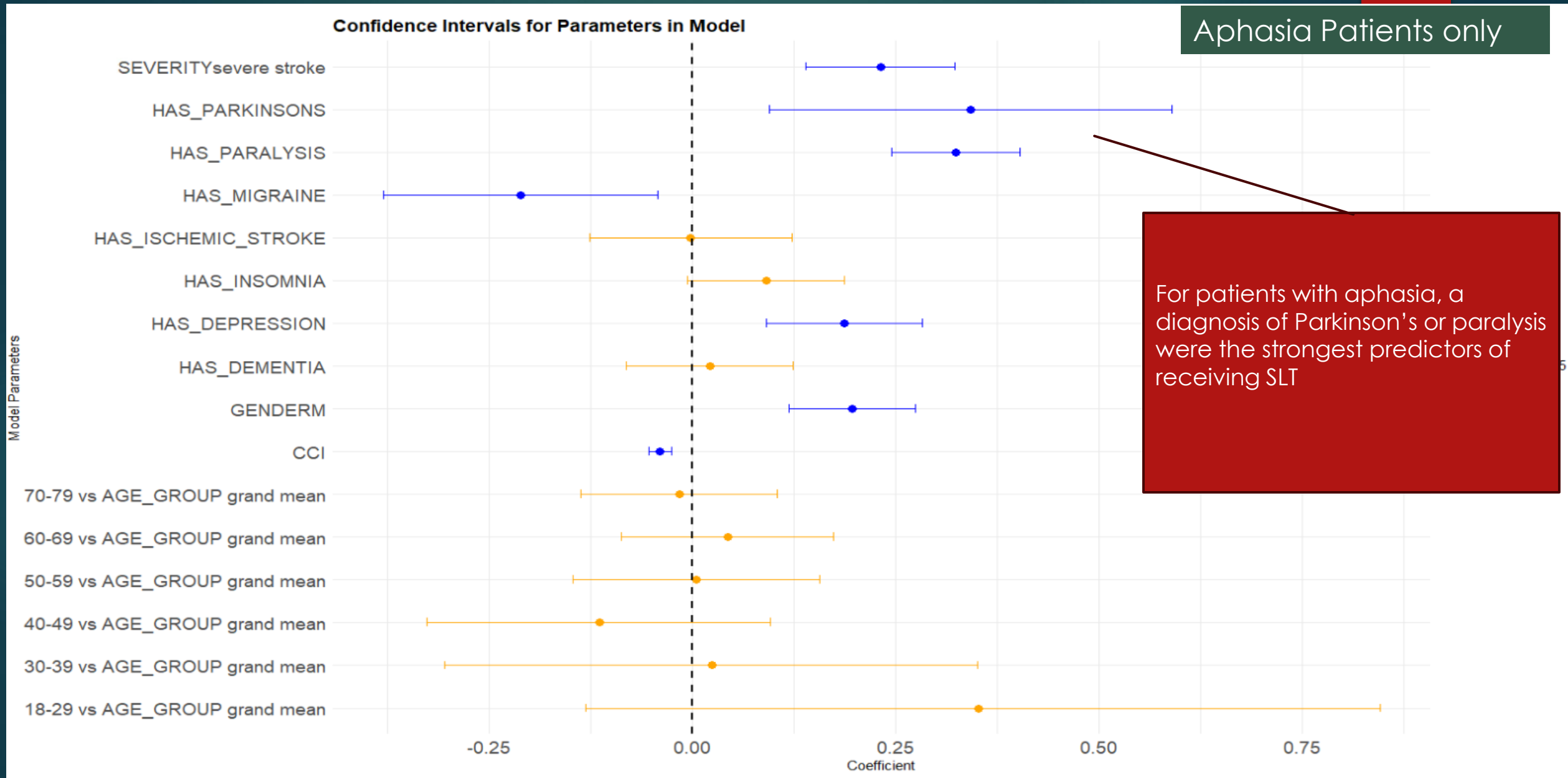
Parameter	Coefficient	SE	95% CI	z	df	p
(Intercept)	-0.28	0.09	[-0.45, -0.11]	-3.25	Inf	0.001
HAS PARKINSONS	0.34	0.13	[0.10, 0.59]	2.72	Inf	0.007
HAS MIGRAINE	-0.21	0.09	[-0.38, -0.04]	-2.45	Inf	0.014
HAS DEPRESSION	0.19	0.05	[0.09, 0.28]	3.82	Inf	< .001
HAS INSOMNIA	0.09	0.05	[-0.01, 0.19]	1.84	Inf	0.066
HAS DEMENTIA	0.02	0.05	[-0.08, 0.12]	0.41	Inf	0.684
HAS PARALYSIS	0.32	0.04	[0.24, 0.40]	8.01	Inf	< .001
HAS ISCHEMIC STROKE	-2.27e-03	0.06	[-0.13, 0.12]	-0.04	Inf	0.972
SEVERITY [severe stroke]	0.23	0.05	[0.14, 0.32]	4.97	Inf	< .001
GENDER [M]	0.20	0.04	[0.12, 0.27]	4.95	Inf	< .001
AGE GROUP [1]	0.35	0.25	[-0.13, 0.85]	1.42	Inf	0.156
AGE GROUP [2]	0.02	0.17	[-0.30, 0.35]	0.14	Inf	0.886
AGE GROUP [3]	-0.11	0.11	[-0.33, 0.10]	-1.06	Inf	0.288
AGE GROUP [4]	4.78e-03	0.08	[-0.15, 0.16]	0.06	Inf	0.951
AGE GROUP [5]	0.04	0.07	[-0.09, 0.17]	0.66	Inf	0.511
AGE GROUP [6]	-0.02	0.06	[-0.14, 0.10]	-0.26	Inf	0.796
CCI	-0.04	7.09e-03	[-0.05, -0.03]	-5.64	Inf	< .001

Model results for patients with aphasia

Aphasia Patients only

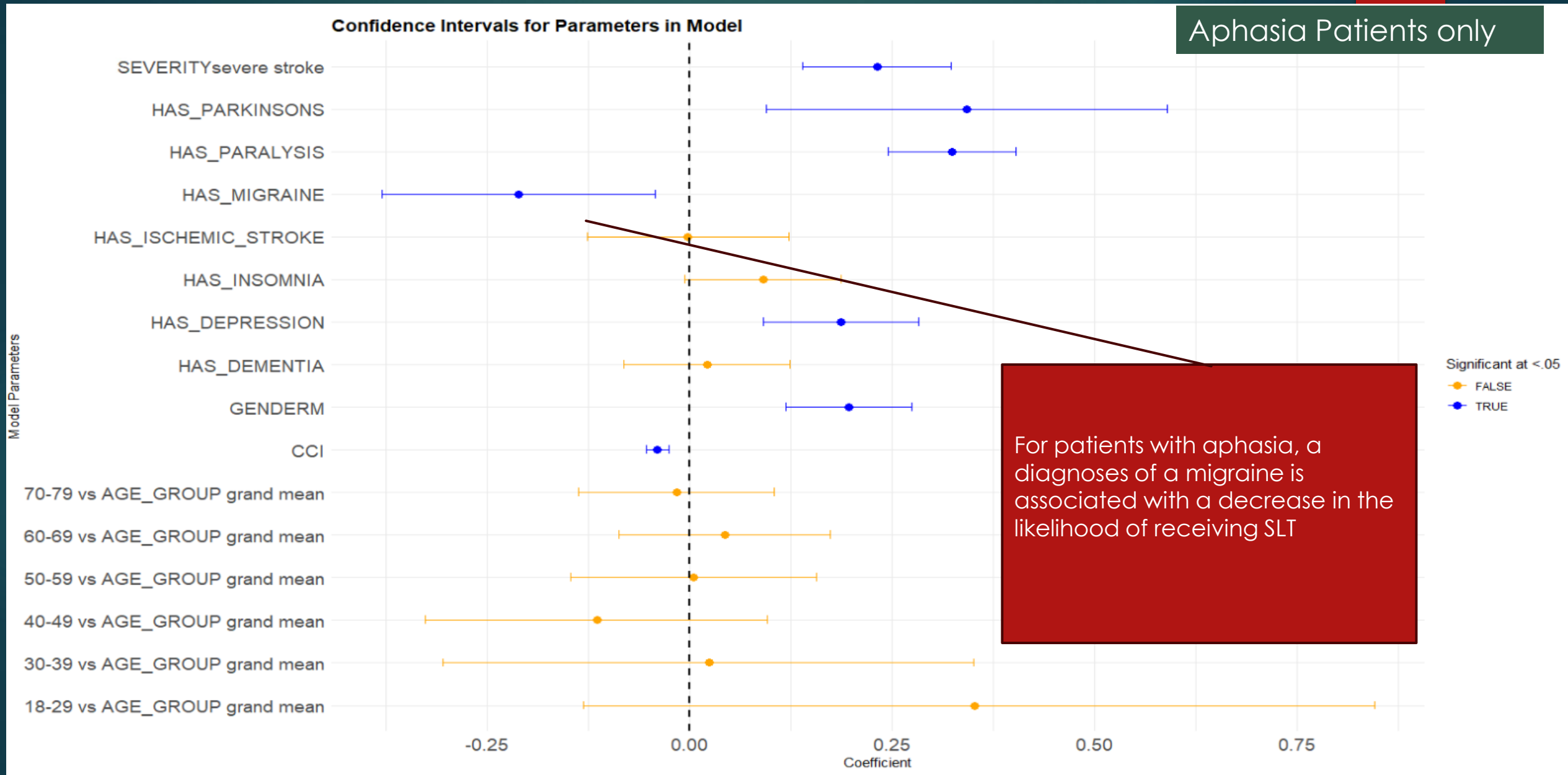


Aphasia Patients only



For patients with aphasia, a diagnosis of Parkinson's or paralysis were the strongest predictors of receiving SLT

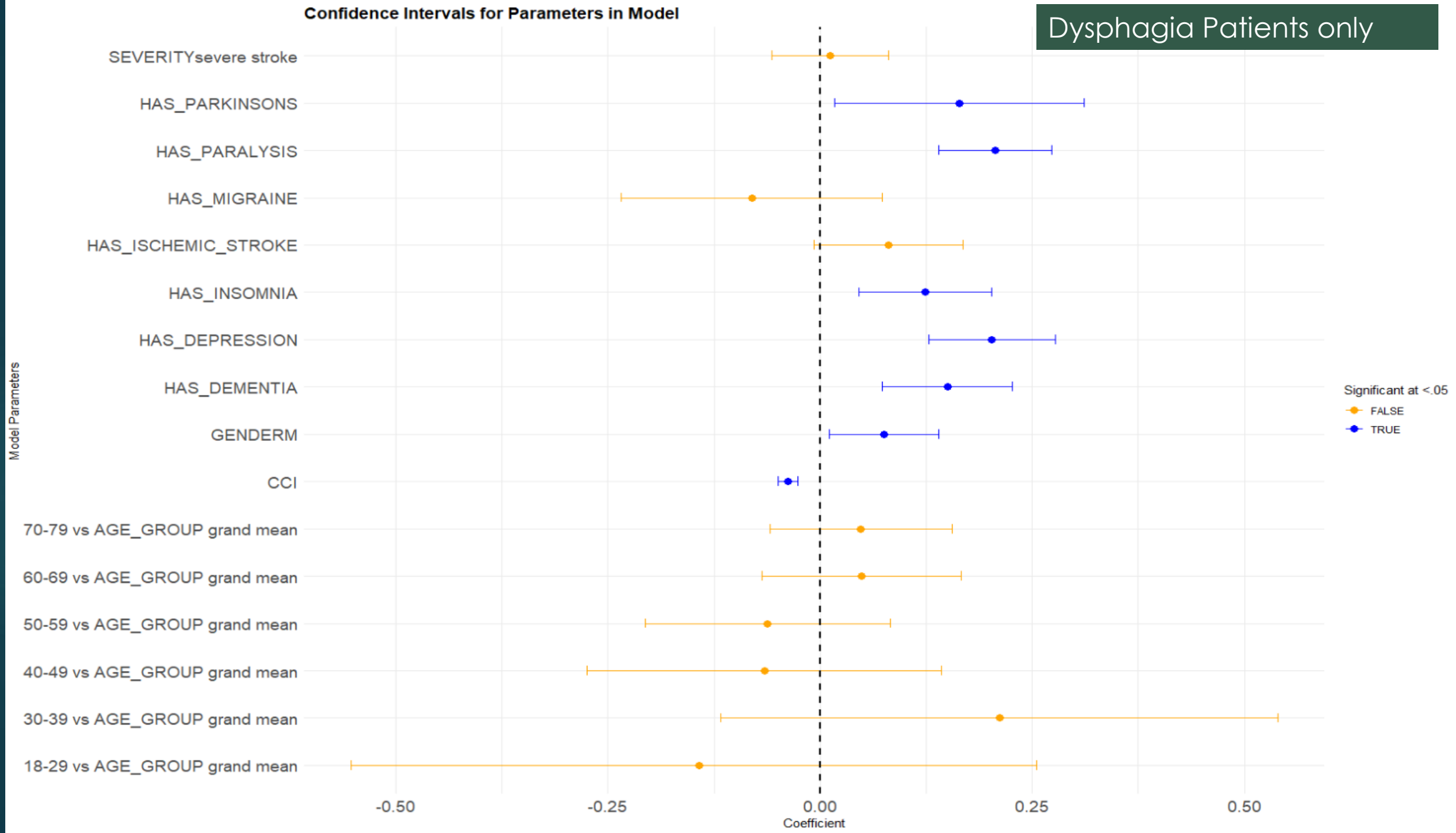
Aphasia Patients only

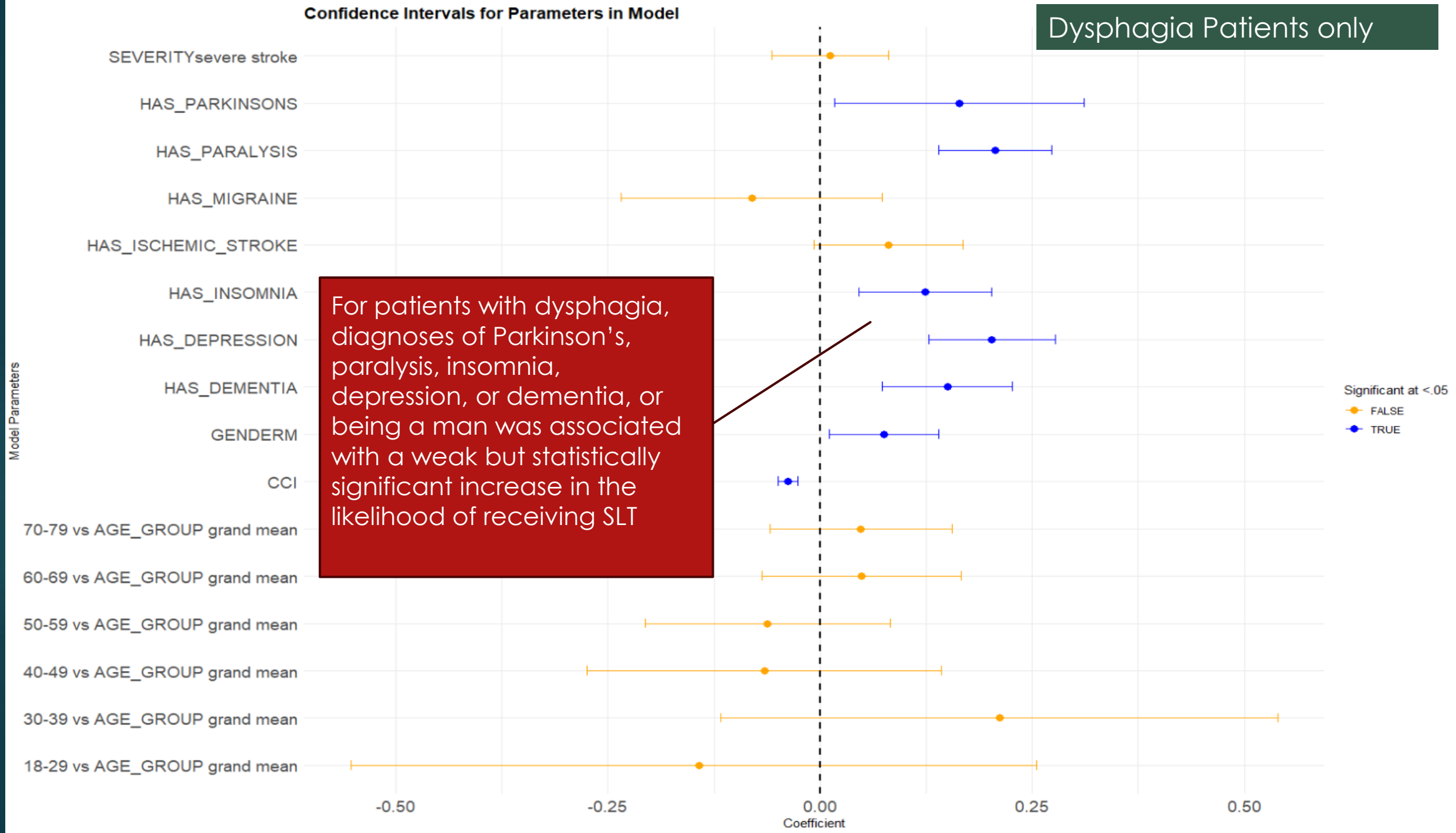


For patients with aphasia, a diagnoses of a migraine is associated with a decrease in the likelihood of receiving SLT

Parameter	Coefficient	SE	95% CI	z	df	p
(Intercept)	-0.37	0.07	[-0.50, -0.24]	-5.40	Inf	< .001
HAS PARKINSONS	0.16	0.07	[0.02, 0.31]	2.20	Inf	0.028
HAS MIGRAINE	-0.08	0.08	[-0.23, 0.07]	-1.02	Inf	0.307
HAS DEPRESSION	0.20	0.04	[0.13, 0.28]	5.32	Inf	< .001
HAS INSOMNIA	0.12	0.04	[0.05, 0.20]	3.10	Inf	0.002
HAS DEMENTIA	0.15	0.04	[0.07, 0.23]	3.84	Inf	< .001
HAS PARALYSIS	0.21	0.03	[0.14, 0.27]	6.07	Inf	< .001
HAS ISCHEMIC STROKE	0.08	0.04	[-0.01, 0.17]	1.79	Inf	0.074
SEVERITY [severe stroke]	0.01	0.04	[-0.06, 0.08]	0.34	Inf	0.737
GENDER [M]	0.08	0.03	[0.01, 0.14]	2.27	Inf	0.023
AGE GROUP [1]	-0.14	0.21	[-0.55, 0.25]	-0.70	Inf	0.486
AGE GROUP [2]	0.21	0.17	[-0.12, 0.54]	1.27	Inf	0.205
AGE GROUP [3]	-0.06	0.11	[-0.27, 0.14]	-0.61	Inf	0.542
AGE GROUP [4]	-0.06	0.07	[-0.21, 0.08]	-0.84	Inf	0.401
AGE GROUP [5]	0.05	0.06	[-0.07, 0.17]	0.81	Inf	0.418
AGE GROUP [6]	0.05	0.05	[-0.06, 0.16]	0.88	Inf	0.379
CCI	-0.04	5.74e-03	[-0.05, -0.03]	-6.57	Inf	< .001

Model results for patients with dysphagia


Confidence Intervals for Parameters in Model
Dysphagia Patients only
SEVERITYsevere stroke
HAS_PARKINSONS
HAS_PARALYSIS
HAS_MIGRAINE
HAS_ISCHEMIC_STROKE
HAS_INSOMNIA
HAS_DEPRESSION
HAS_DEMENTIA
GENDERM
CCI
70-79 vs AGE_GROUP grand mean
60-69 vs AGE_GROUP grand mean
50-59 vs AGE_GROUP grand mean
40-49 vs AGE_GROUP grand mean
30-39 vs AGE_GROUP grand mean
18-29 vs AGE_GROUP grand mean
Model Parameters
-0.50
-0.25
0.00
0.25
0.50
Coefficient
Significant at <.05
FALSE
TRUE


Confidence Intervals for Parameters in Model
Dysphagia Patients only
SEVERITYsevere stroke
HAS_PARKINSONS
HAS_PARALYSIS
HAS_MIGRAINE
HAS_ISCHEMIC_STROKE
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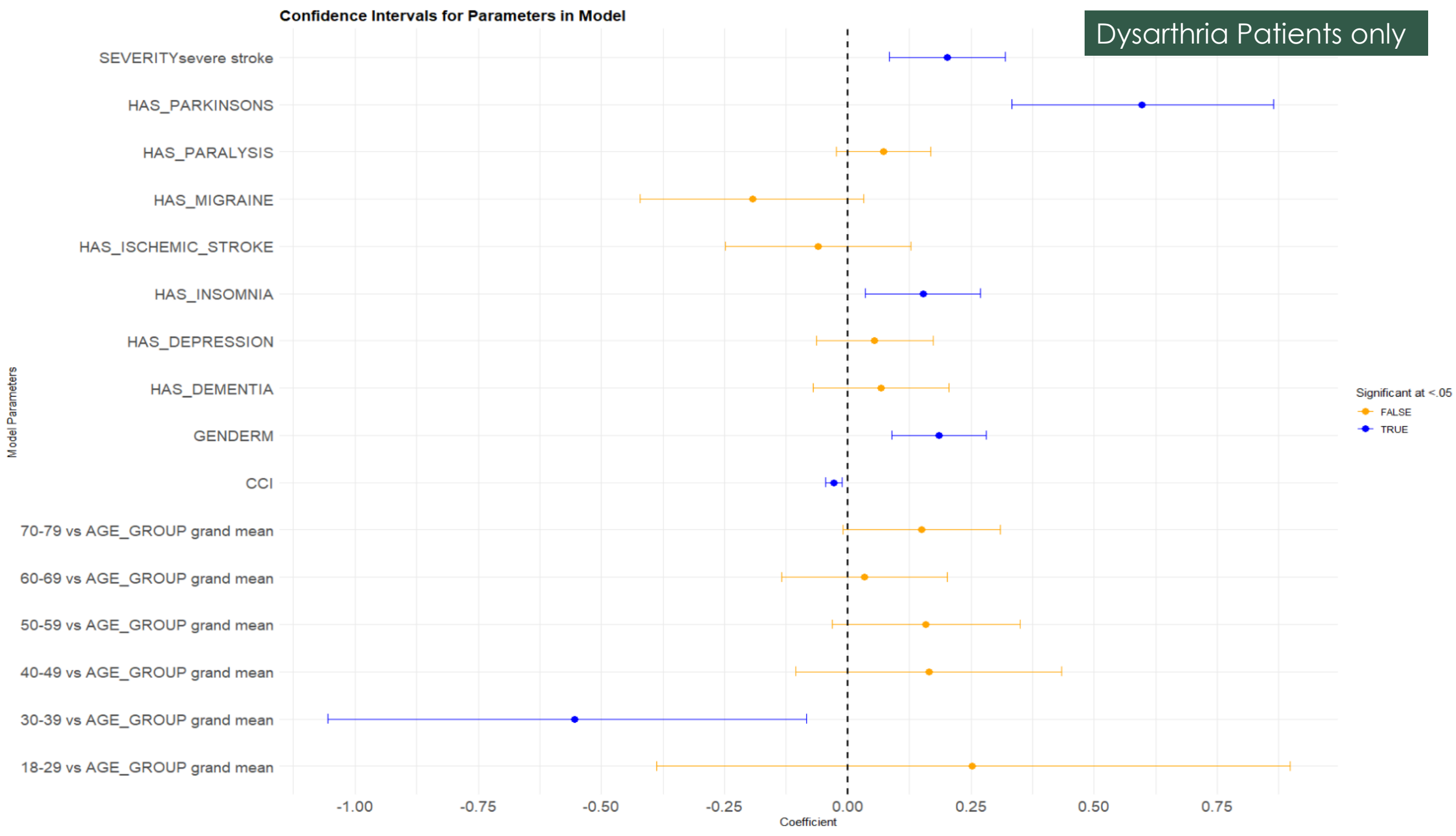
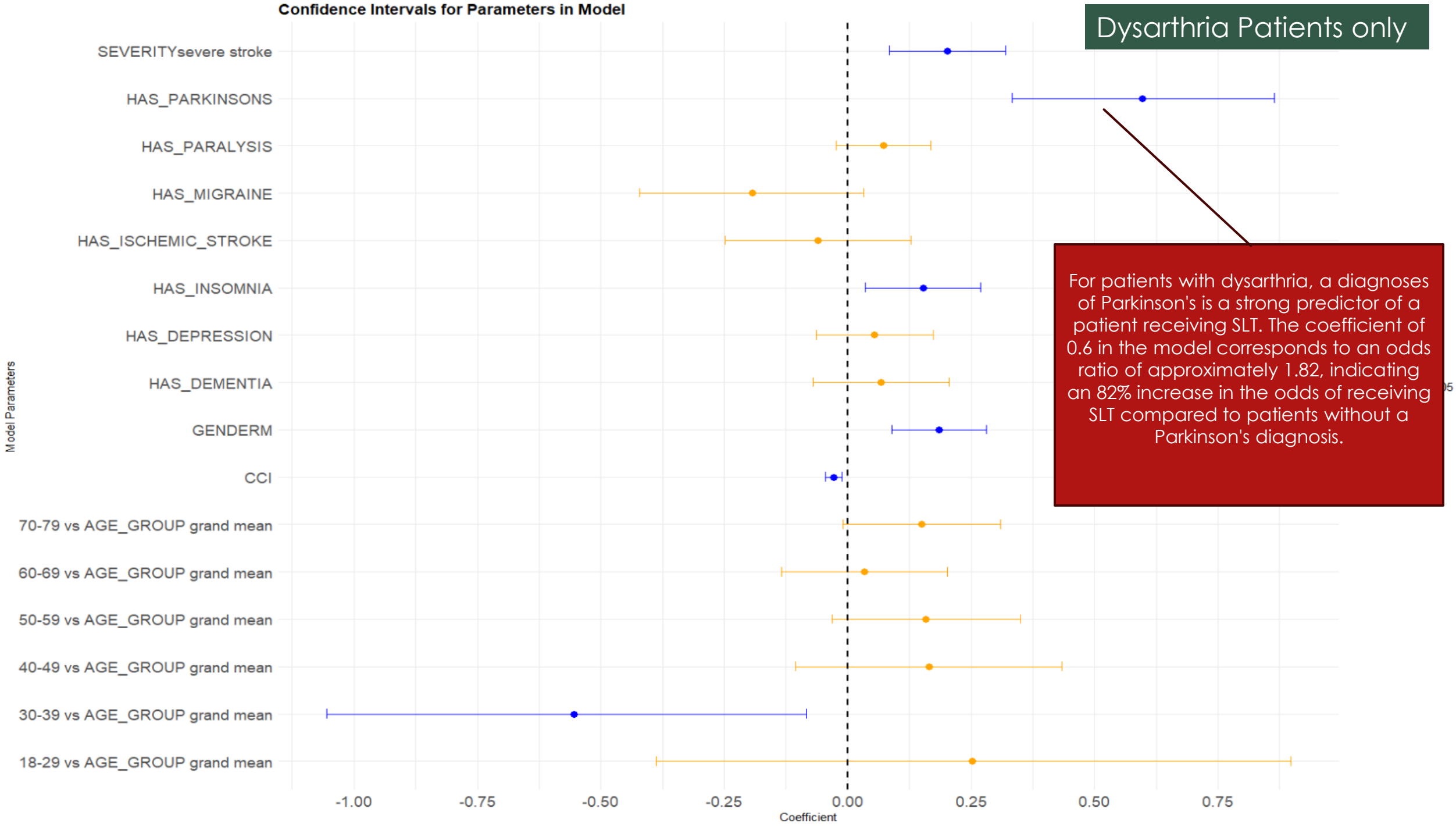
40-49 vs AGE_GROUP grand mean
30-39 vs AGE_GROUP grand mean
18-29 vs AGE_GROUP grand mean
Model Parameters
-0.50
-0.25
0.00
0.25
0.50
Coefficient
Significant at <.05
FALSE
TRUE
For patients with dysphagia, diagnoses of Parkinson's, paralysis, insomnia, depression, or dementia, or being a man was associated with a weak but statistically significant increase in the likelihood of receiving SLT

Parameter	Coefficient	SE	95% CI	z	df	p
(Intercept)	-0.29	0.12	[-0.53, -0.06]	-2.42	Inf	0.015
HAS PARKINSONS	0.60	0.14	[0.33, 0.86]	4.42	Inf	< .001
HAS MIGRAINE	-0.19	0.12	[-0.42, 0.03]	-1.66	Inf	0.096
HAS DEPRESSION	0.05	0.06	[-0.06, 0.17]	0.90	Inf	0.366
HAS INSOMNIA	0.15	0.06	[0.04, 0.27]	2.56	Inf	0.010
HAS DEMENTIA	0.07	0.07	[-0.07, 0.21]	0.97	Inf	0.332
HAS PARALYSIS	0.07	0.05	[-0.02, 0.17]	1.49	Inf	0.136
HAS ISCHEMIC STROKE	-0.06	0.10	[-0.25, 0.13]	-0.63	Inf	0.528
SEVERITY [severe stroke]	0.20	0.06	[0.08, 0.32]	3.36	Inf	< .001
GENDER [M]	0.18	0.05	[0.09, 0.28]	3.77	Inf	< .001
AGE GROUP [1]	0.25	0.32	[-0.39, 0.90]	0.78	Inf	0.437
AGE GROUP [2]	-0.55	0.25	[-1.05, -0.08]	-2.25	Inf	0.024
AGE GROUP [3]	0.16	0.14	[-0.11, 0.43]	1.20	Inf	0.232
AGE GROUP [4]	0.16	0.10	[-0.03, 0.35]	1.63	Inf	0.104
AGE GROUP [5]	0.03	0.09	[-0.13, 0.20]	0.39	Inf	0.696
AGE GROUP [6]	0.15	0.08	[-0.01, 0.31]	1.85	Inf	0.064
CCI	-0.03	8.86e-03	[-0.05, -0.01]	-3.21	Inf	0.001

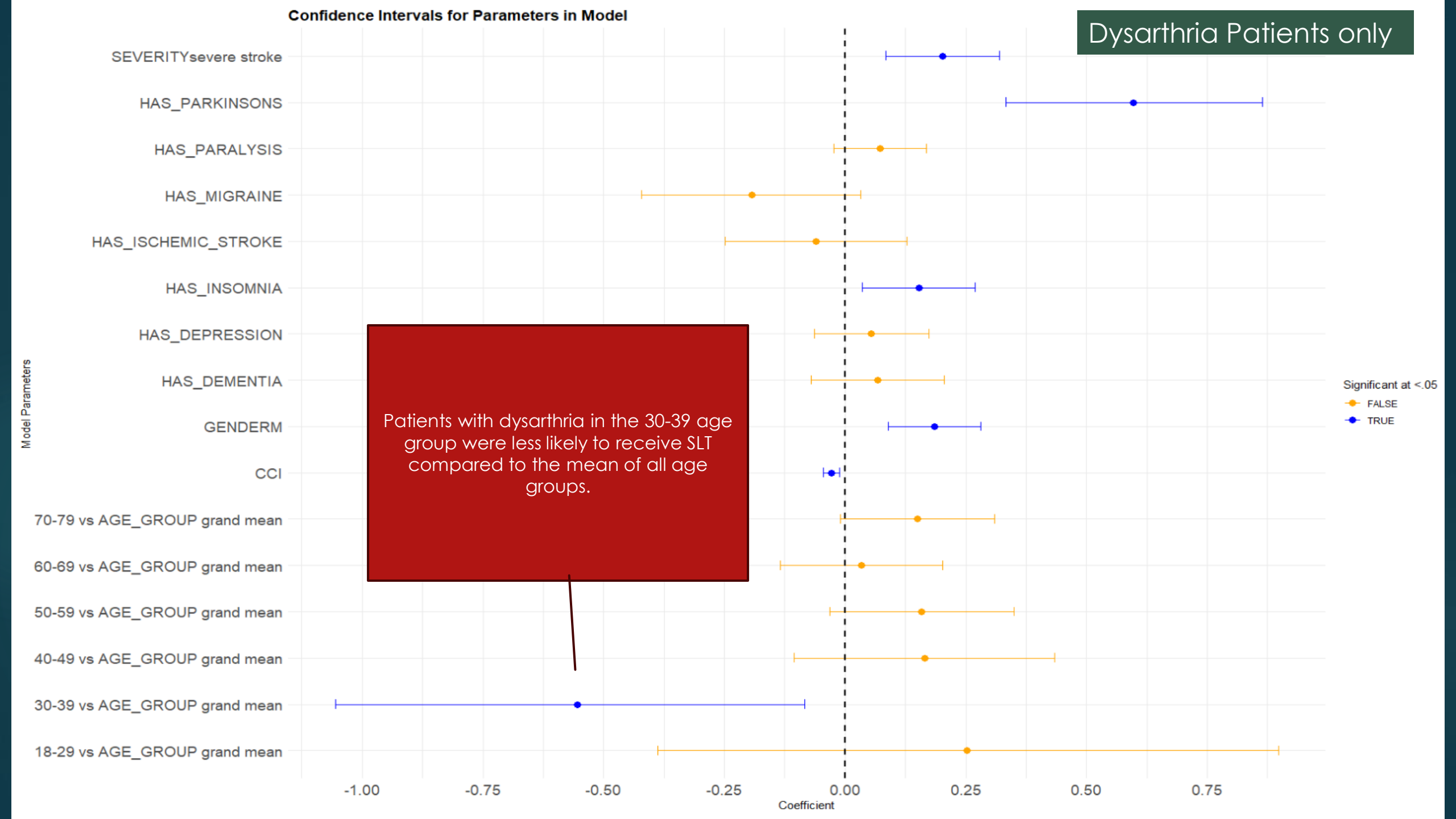
Model results for patients with dysarthria


Confidence Intervals for Parameters in Model
Dysarthria Patients only
SEVERITYsevere stroke
HAS_PARKINSONS
HAS_PARALYSIS
HAS_MIGRAINE
HAS_ISCHEMIC_STROKE
HAS_INSOMNIA
HAS_DEPRESSION
HAS_DEMENTIA
GENDERM
CCI
70-79 vs AGE_GROUP grand mean
60-69 vs AGE_GROUP grand mean
50-59 vs AGE_GROUP grand mean
40-49 vs AGE_GROUP grand mean
30-39 vs AGE_GROUP grand mean
18-29 vs AGE_GROUP grand mean
Model Parameters
-1.00
-0.75
-0.50
-0.25
0.00
0.25
0.50
0.75
Coefficient
Significant at <.05
FALSE
TRUE

Dysarthria Patients only



For patients with dysarthria, a diagnoses of Parkinson's is a strong predictor of a patient receiving SLT. The coefficient of 0.6 in the model corresponds to an odds ratio of approximately 1.82, indicating an 82% increase in the odds of receiving SLT compared to patients without a Parkinson's diagnosis.


Confidence Intervals for Parameters in Model
Dysarthria Patients only
SEVERITYsevere stroke
HAS_PARKINSONS
HAS_PARALYSIS
HAS_MIGRAINE
HAS_ISCHEMIC_STROKE
HAS_INSOMNIA
HAS_DEPRESSION
HAS_DEMENTIA
GENDERM
CCI
70-79 vs AGE_GROUP grand mean
60-69 vs AGE_GROUP grand mean
50-59 vs AGE_GROUP grand mean
40-49 vs AGE_GROUP grand mean
30-39 vs AGE_GROUP grand mean
18-29 vs AGE_GROUP grand mean
Model Parameters
Patients with dysarthria in the 30-39 age group were less likely to receive SLT compared to the mean of all age groups.
-1.00
-0.75
-0.50
-0.25
0.00
0.25
0.50
0.75
Coefficient
Significant at <.05
FALSE
TRUE

Discussion

Limitations

- 1623 patients out of 25,000 cohort (6.3%) did not have a CCI score and it is unclear why). I made the decision to impute the median CCI score to the rows that were missing. Is the missingness random, or does the missingness reflect something about those patients?
  - Running the model after dropping those rows affected the statistical significance and importance of some variables including the age groups
- Age variable is limited in the Pharmetrix+ database compared to German study because patients born before or during 1937 are all binned into one year.

Key Findings

- For stroke patients that were diagnosed with one or more speech disorders, a recent or concurrent diagnosis of **Parkinson's Disease, insomnia, depression, paralysis, or dementia** were associated with increased likelihood that the patient received speech-language therapy (SLT). **Men were more likely to get SLT than women**, and **patients with severe strokes** were more likely to get SLT than patients with milder strokes.

- For patients with dysarthria, a diagnoses of Parkinson's is a strong predictor of a patient receiving SLT.

- Among all models, coefficients were almost always not statistically significant for the age group variable.

Opportunities for Future Work

- Investigate missing CCI data
- Closely compare model results between datasets with missing rows dropped vs imputed
- Experiment with other methods of contrast coding for the age group variable
- Build linear regression models for other target variables:
  1. The time gap between inpatient discharge and initiation of SLT
  2. Average frequency of SLT sessions

Acknowledgments

- Thanks to Rob Cavanaugh for his guidance and mentorship